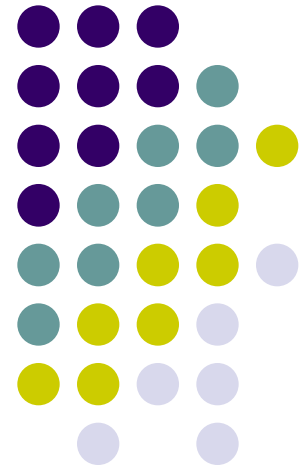


# TB and The Kidney:

## *Questions and Teaching Points*

**Hussein Sheashaa, MD**

Professor of Internal Medicine (Nephrology) and manager of Quality Assurance Unit, Urology and Nephrology Center and Director of Medical E-Learning Unit,  
Mansoura University













# Outline



- ❖ **Introduction**
- ❖ **Urinary TB**
- ❖ **Electrolytes and acid base disturbance**
- ❖ **AKI**
- ❖ **TB and ESRD**

# Is It True or False?



1. Latent TB affects one 1/3 of whole world.
2. Quantiferon test measures the number of active T cells.
3. Genitourinary TB (GUTB) is the most common extrapulmonary TB.
4. GUTB affects male aged less than 20 years.
5. Kidney is the most common site of GUTB.

# Is It True or False?



1. Renal medulla is the most common site of involvement of clinical renal TB.
2. CT or MR images are definitive in diagnosing urinary TB.
3. Xpert MTB/RIF is a new culture takes 42 days.
4. INH may cause normal anion gap acidosis.
5. Rifampicin is a common culprit causing TIN.
6. Ethambutol is the most potent enzyme inducer among anti-TB drugs.

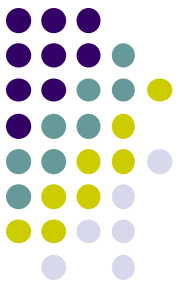


# Introduction

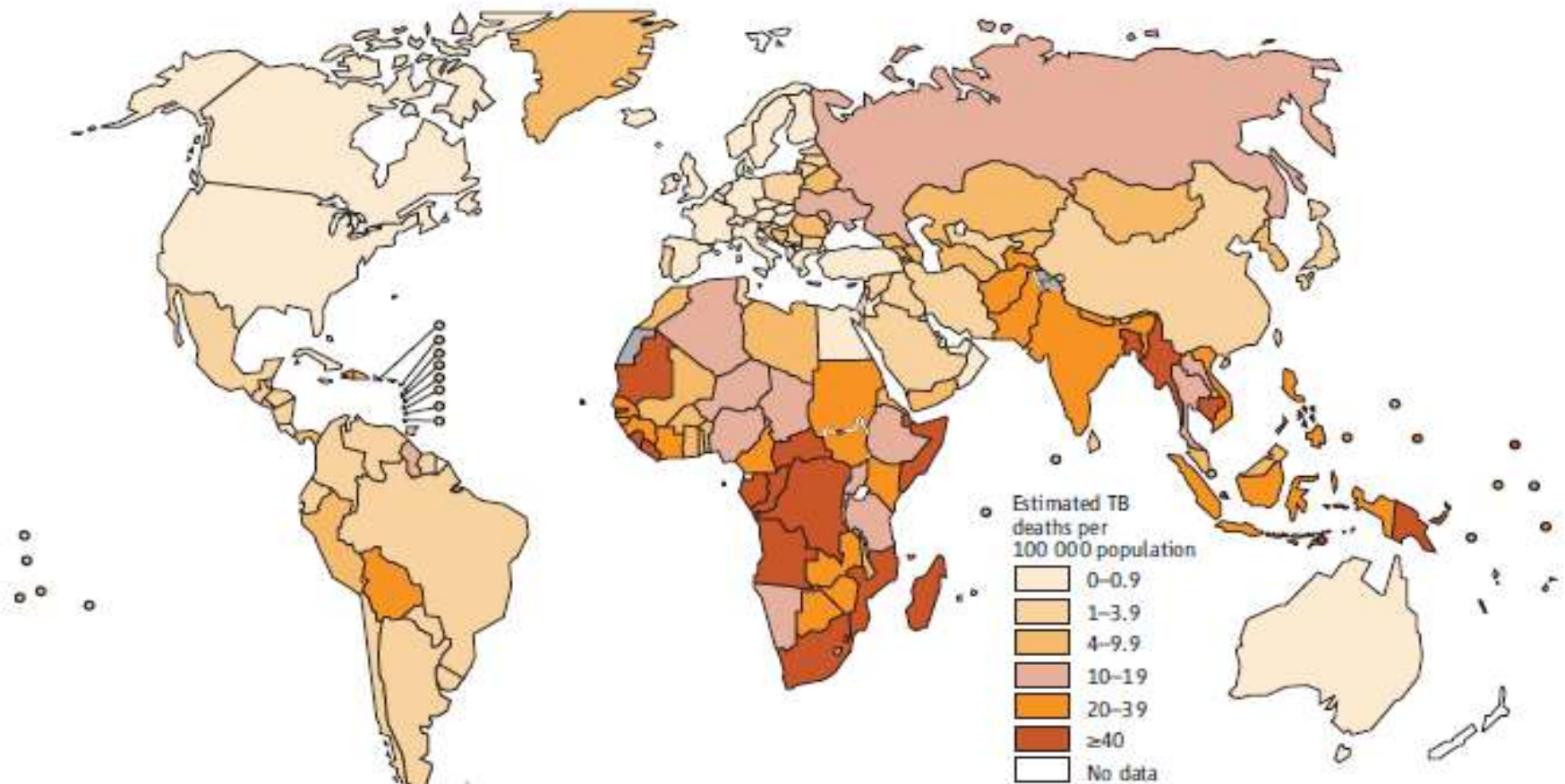


- ❖ The resurgence of TB has been noted in both endemic and non-endemic regions
- ❖ The genitourinary tract is the most common site of extra-pulmonary TB
- ❖ TB and HIV?

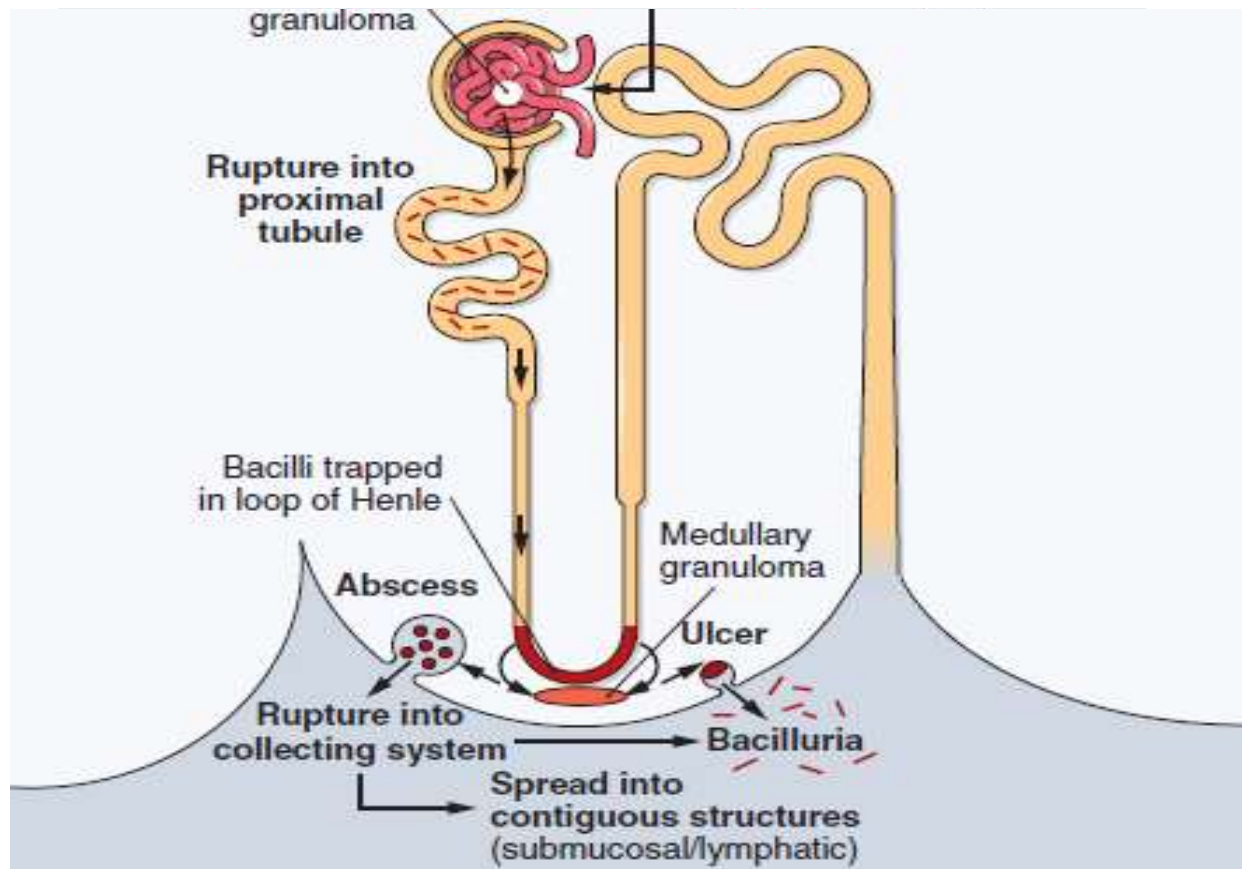
# Introduction



Estimated TB mortality rates excluding TB deaths among HIV-positive people, 2012



# Urinary TB: Pathophysiology



Comprehensive textbook of Nephrology 2010

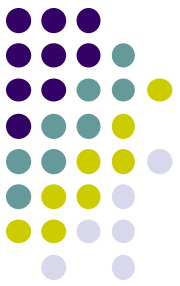
# Urinary TB:

## Clinical Manifestations



- Age: 20-40y
- Male/female ratio: 2:1
- Nearly 25% of patients have no clinical or laboratory evidence of abnormality





# Urinary TB:

## Clinical Manifestations

Features	Frequency (%)	Symptoms
Asymptomatic	25	Detected during autopsy, surgery, or investigations for other diseases
Asymptomatic urinary abnormalities	25	Persistent pyuria, microscopic abnormalities, hematuria
Lower urinary tract symptoms (most common)	40	Frequency, urgency, dysuria, incontinence, nocturia, suprapubic pain, perineal pain
Male genital tract involvement	75	Epididymitis, hemospermia, infertility, reduced semen volume
Female genital tract involvement	<5	Amenorrhea, infertility, vaginal bleeding, pelvic pain
Constitutional symptoms	<20	Fever, reduced appetite, anorexia, weight loss, night sweats
Miscellaneous	—	Urolithiasis, hypertension, acute kidney injury, chronic kidney disease, abdominal colic, abdominal mass

Comprehensive textbook of Nephrology 2010

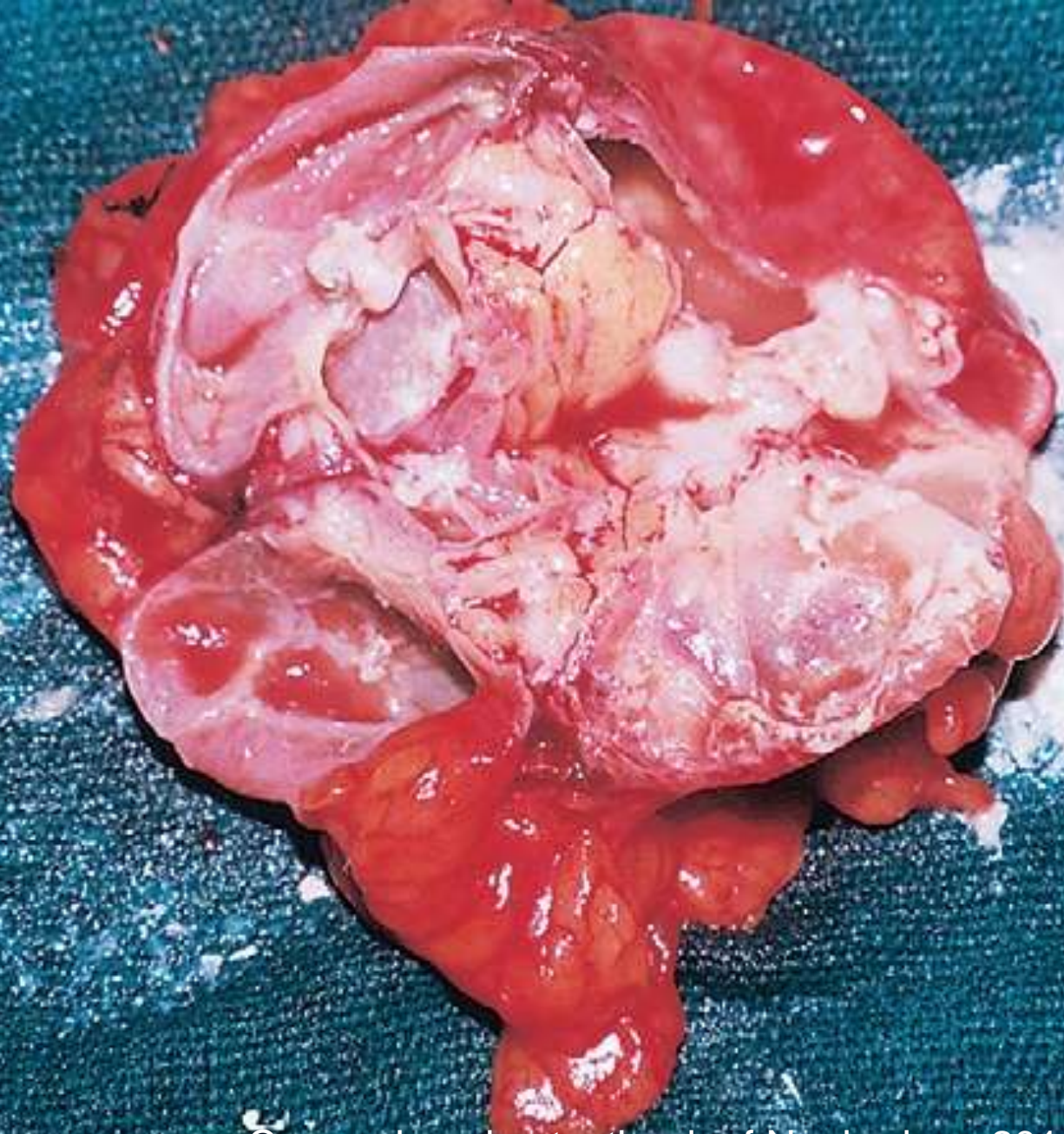
# Urinary TB:

## Clinical Manifestations



- Tubular proteinuria < 1gm/d in more than 50% of long standing TB.
- > 1gm/day in 15%
- Nephrotic: Amyloid
- Mesangial proliferative GN





Comprehensive textbook of Nephrology 2010

The 9<sup>th</sup> Annual Conference of Internal Medicine Dept., Mansoura University, April 29<sup>th</sup> – May 2<sup>nd</sup>, 2014

# Diagnosis



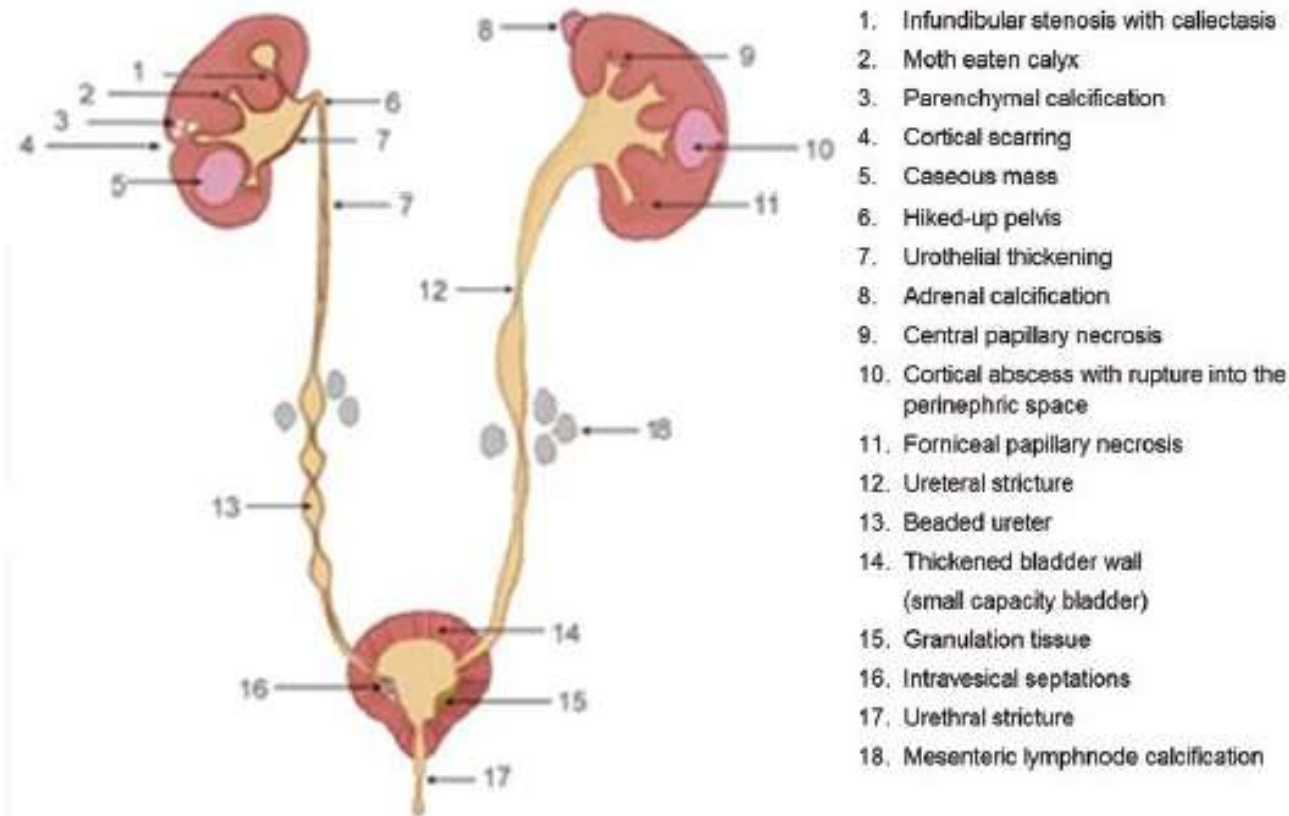
- Clinical:
- Radiological:
- Bacteriological:

Probability  
Possibility  
Certainty



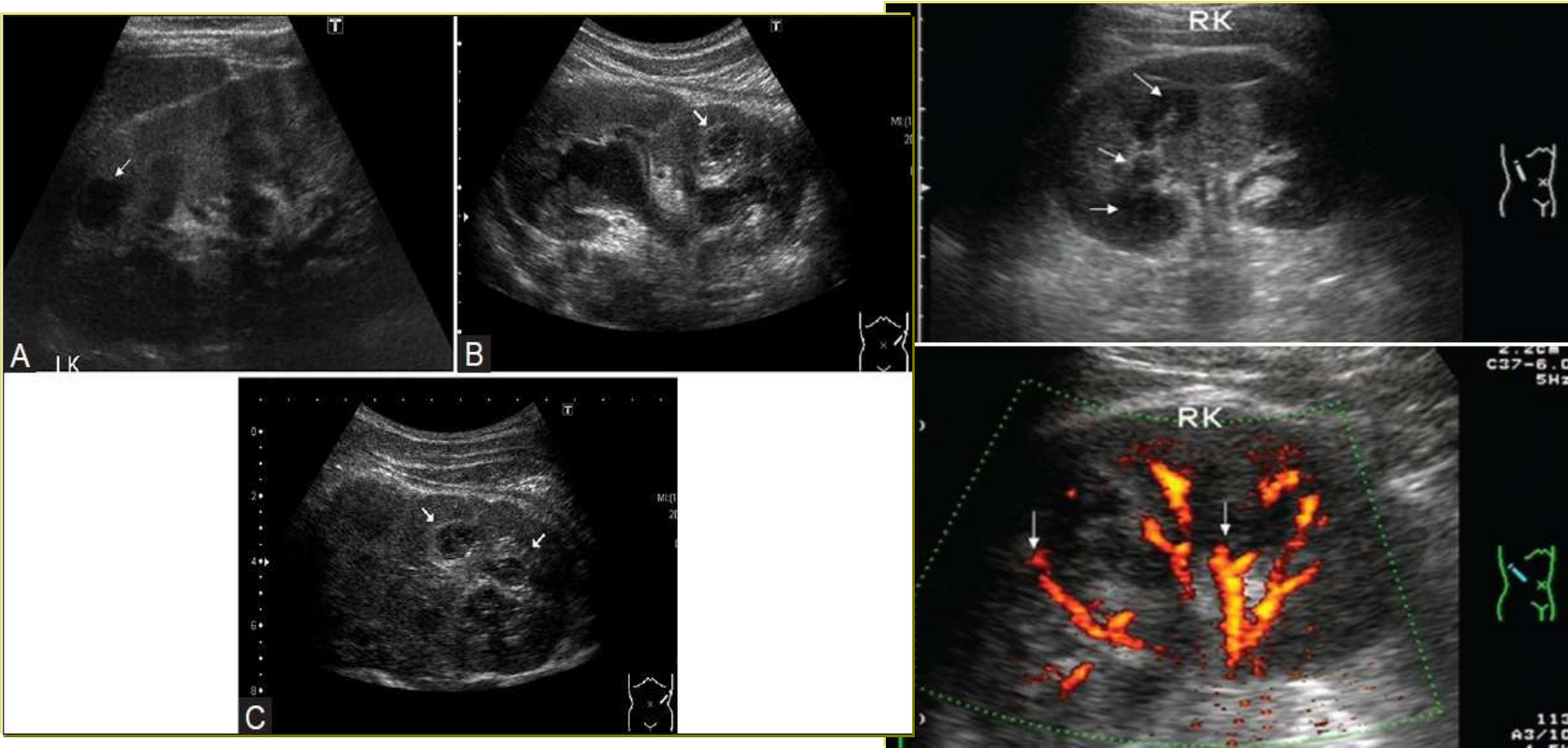
# Urinary TB:

## Imaging



Indian J Radiol Imaging. 2013 Jan-Mar; 23(1): 46–63.

# Urinary TB: US



Indian J Radiol Imaging. 2013 Jan-Mar; 23(1): 46–63.

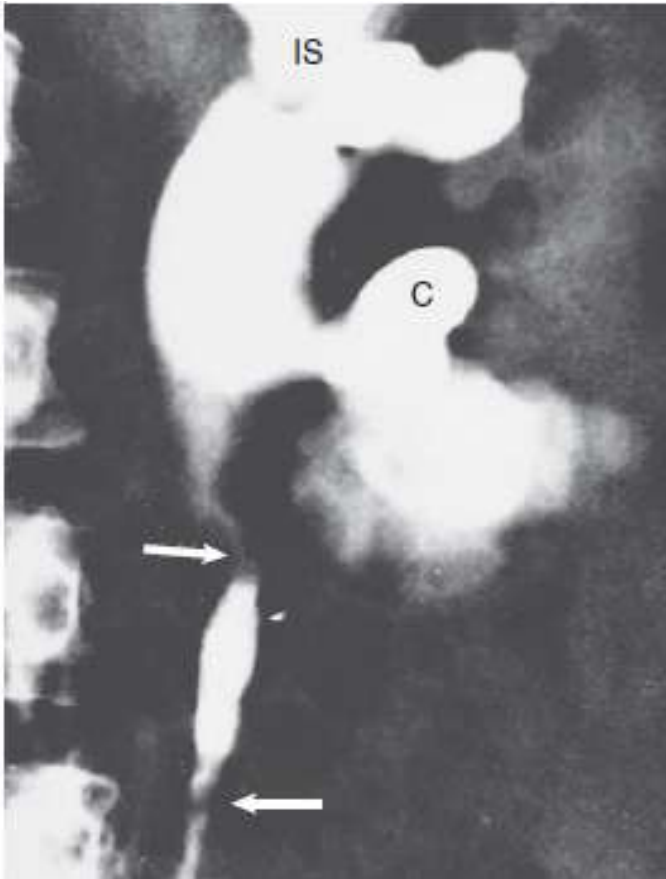
# Urinary TB: Plain Xray-IVU



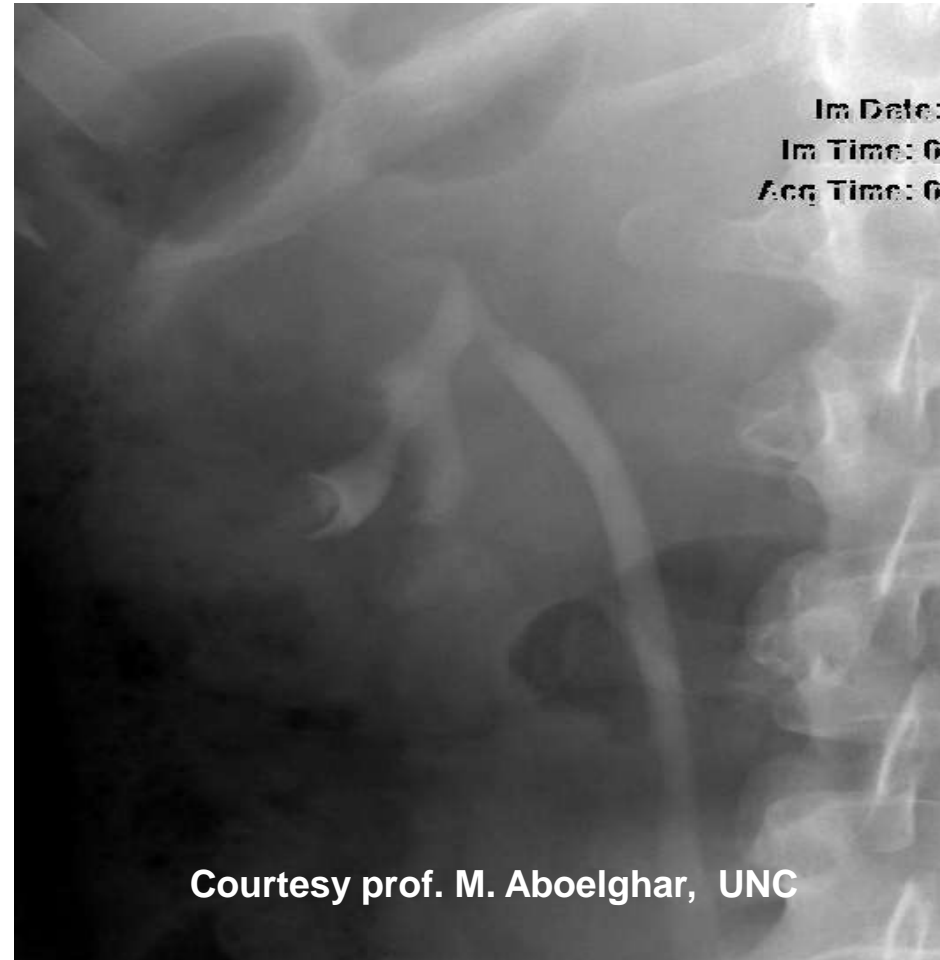
Indian J Radiol Imaging. 2013 Jan-Mar; 23(1): 46–63.

# Urinary TB:

## IVU/Retrograde Pyelography



Comprehensive textbook of Nephrology 2010





# Urinary TB: CT



Courtesy prof. M. Aboelghar, UNC



Courtesy prof. M. Aboelghar, UNC

# Urinary TB: MRI



Indian J Radiol Imaging. 2013 Jan-Mar; 23(1): 64–77.

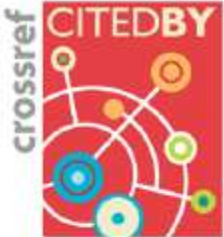
# Urinary TB: Cystogram



Comprehensive textbook of Nephrology 2010



# Microbiology



MEDITERRANEAN JOURNAL OF HEMATOLOGY AND INFECTIOUS DISEASES

[www.mjhid.org](http://www.mjhid.org) ISSN 2035-3006

## Original Article

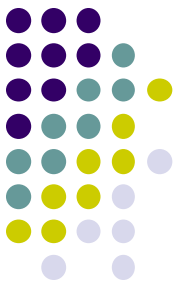
### **Assessment of Diagnostic Techniques of Urinary Tuberculosis**

Sensitivity and Specificity of different methods.

Test performed	Sensitivity (%)	Specificity (%)
Z.N. smear	25	100
L.J. medium	25	100
BACTEC system	37.5	100
PCR test	100	100

Mediterr J Hematol Infect Dis 2013; 5: Open Journal System

# Diagnosis: Xpert MTB/RIF



Articles



Feasibility, diagnostic accuracy, and effectiveness of decentralised use of the Xpert MTB/RIF test for diagnosis of tuberculosis and multidrug resistance: a multicentre implementation study



Catharina C Boehme, Mark P Nicol, Pamela Nabeta, Joy S Michael, Eduardo Gotuzzo, Rasim Tahirli, Ma Tarcela Gler, Robert Blakemore, William Worodria, Christen Gray, Laurence Huang, Tatiana Caceres, Rafail Mehdiyev, Lawrence Raymond, Andrew Whitelaw, Kalaiselvan Sagadevan, Heather Alexander, Heidi Albert, Frank Cobelens, Helen Cox, David Alland, Mark D Perkins

***Lancet 2011; 377: 1495–1505***

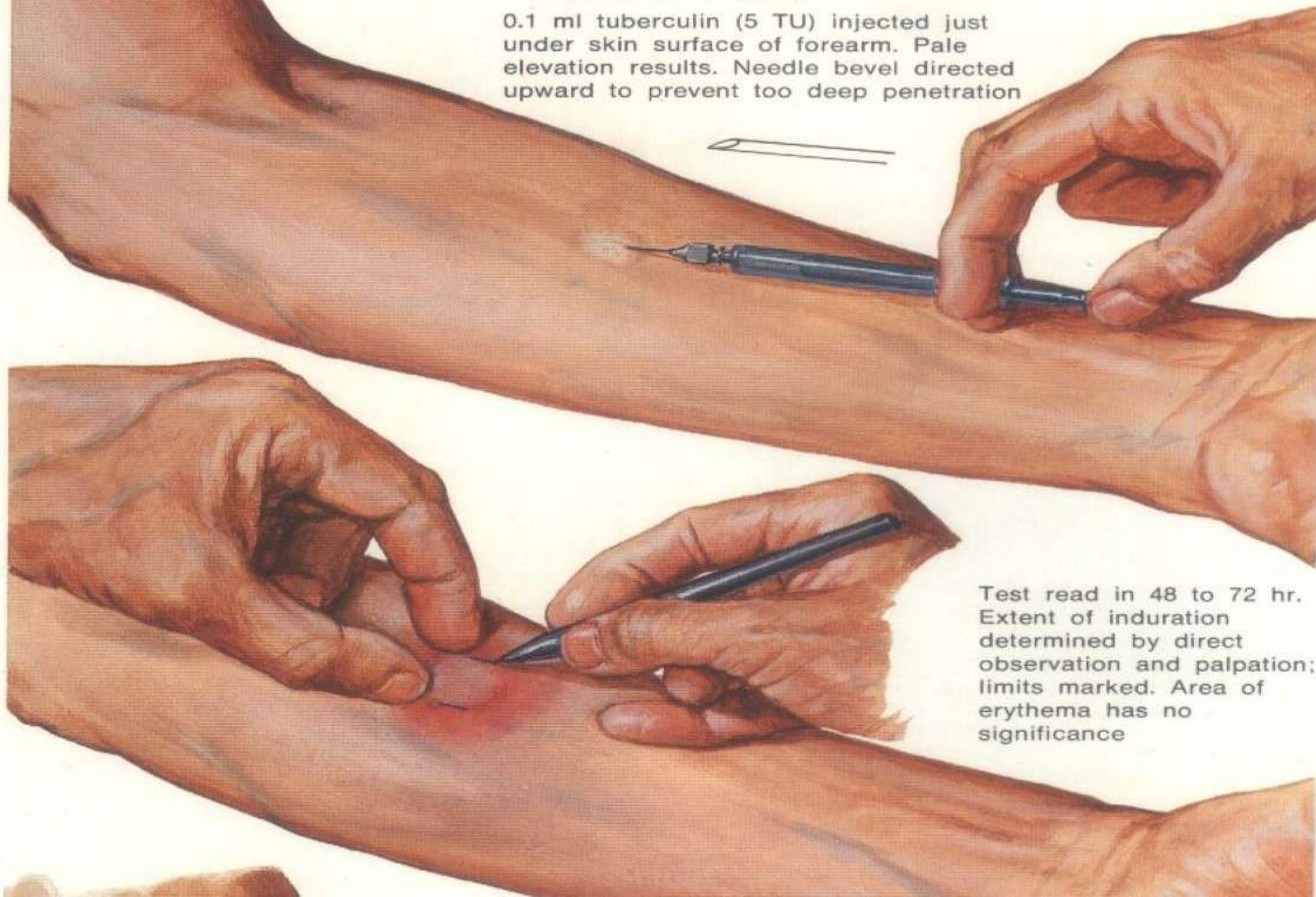
# TB in ESRD



- More common: Prevalence ~ 10 % (*Abdalhafez S., et al. Chest J, 2003*)
- Atypical
- TB peritonitis in CAPD
- Increased morbidity and mortality
- Increased side effects of antituberculous

## Tuberculin Testing

0.1 ml tuberculin (5 TU) injected just under skin surface of forearm. Pale elevation results. Needle bevel directed upward to prevent too deep penetration



Test read in 48 to 72 hr. Extent of induration determined by direct observation and palpation; limits marked. Area of erythema has no significance



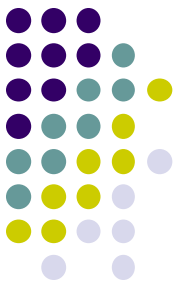
# Diagnosis of Latent TB in Dialysis



	T-SPOT.TB	QFT-G	TST
Antigens	ESAT-6 and CFP-10	ESAT-6 and CFP10	PPD
Positive internal control	Yes	Yes	No
Uniformity of methods and reagents	Yes	Yes	No <sup>a</sup>
Potential for boosting effect in repeated tests	No	No	Yes
Need for return visit	No	No	Yes
Time required for results	16 to 20 hours	16 to 24 hours	48 to 72 hours
Setting of test	<i>In vitro</i>	<i>In vitro</i>	<i>In vivo</i>
Interpretation of test	Objective (instrument-based)	Objective (instrument-based)	Subjective (operator-based)
Readout units	IFN- $\gamma$ spot-forming cells	International units of IFN- $\gamma$	Millimeters of induration
Technological platform	T-SPOT.TB	ELISA	NA
Test's substrate	PBMC	Whole blood	NA
Outcome measure	Number of IFN- $\gamma$ -producing T cells	Serum concentration of IFN- $\gamma$ produced by T cells	NA
Readout system	Enumeration of spots by naked eye, magnifying lens, or automated counter	Measurement of optical density values using an automated reader	Palpable induration

Clin J Am Soc Nephrol 5: 1114–1122, 2010

# Diagnosis of TB in Dialysis



Study (Reference)	n	Objective	IGRA	Sensitivity (%)	Specificity (%)	Indeterminate Results (%)
Inoue <i>et al.</i>	162 HD	Diagnosis of active TB	QFT-G	100	89.7	24.1
Zoccali <i>et al.</i>	29 HD	Diagnosis of active TB	T-SPOT.TB	91.7	64.7	NA
Passalent <i>et al.</i>	203 HD	Diagnosis of LTBI	T-SPOT.TB	73.1 to 78.6	NA	5.1
Triverio <i>et al.</i>	62 HD	Diagnosis of LTBI	T-SPOT.TB	22	61.2	11.0
			QFT-G	46	75.5	8.0
Chung <i>et al.</i>	167 HD	Diagnosis of LTBI	T-SPOT.TB	65.7	41.9	4.8
			QFT-G	62.5	63.5	12.6
Hoffmann <i>et al.</i>	39 HD	Diagnosis of LTBI	QFT-GIT	71.4	100	2.6

Clin J Am Soc Nephrol 5: 1114–1122, 2010

# Diagnostics



## Technologies in early development

### Volatile organic compounds

- BreathLink, Menssana Research, USA
- Prototype breath analyzer device, Next Dimensions Technology, USA

### Molecular technologies

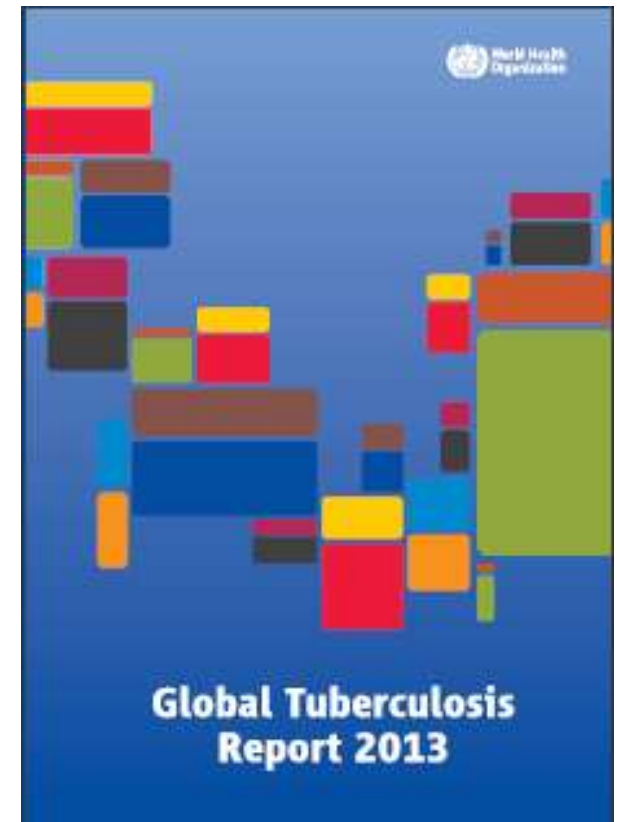
- Alere Q, Alere, USA
- B-SMART, LabCorp, USA
- Gendrive MTB/RIF ID, Epistem, UK
- LATE-PCR, Brandeis University, USA
- GeneXpert XDR cartridge, Cepheid, USA
- TruArray MDR-TB, Akkoni, USA
- INFINITIMTB Assay, AutoGenomics, USA

### Culture-based technologies

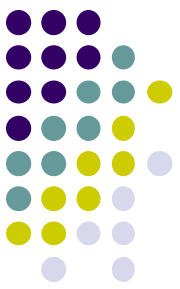
- BNP Middlebrook, NanoLogix, USA
- MDR-XDR TB Color Test, FIND, Switzerland/Imperial College, UK
- TREK Sensititre MYCOTB MIC plate, Trek Diagnostic Systems/Thermo Fisher Scientific, USA

### Other technologies

- TB Rapid Screen, Global BioDiagnostics, USA
- TBDx, Signature Mapping Medical Sciences, USA



# Diagnostics



**Evaluated by WHO but not yet endorsed**

## **Technologies endorsed by WHO**

---

### **Molecular technologies**

- Xpert MTB/RIF
- Line probe assays (acid-fast bacilli smear-positive sputum specimens or culture-positive specimens)

### **Microscopy**

- Ziehl-Neelsen and fluorescence microscopy methods

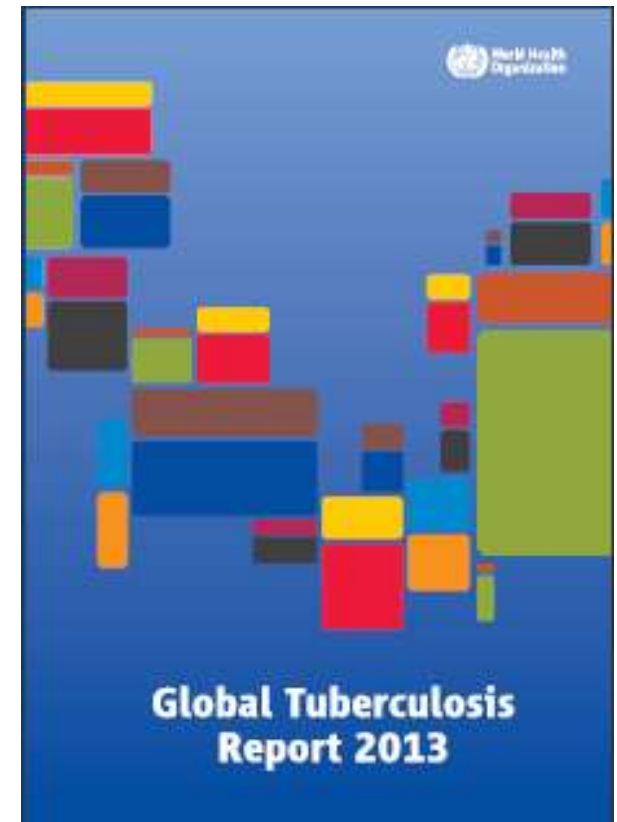
### **Culture-based technologies**

- Commercial liquid culture systems and rapid speciation
- Non-commercial culture and drug susceptibility testing methods

## **Evaluated by WHO and not recommended**

---

- Commercial serodiagnostics (all manufacturers)
- Interferon-gamma release assays for the detection of active TB (all settings)





# Current TB Management

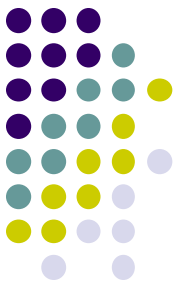


Type of Infection	Recommended Regimen	Comments
Latent infection	Isoniazid at a dose of 300 mg daily for at least 6 mo and preferably for 9 mo	Recommended for 9 mo or more in HIV-infected persons; daily administration for 6 mo also an option but with lower efficacy; extension to 36 mo further reduces risk among HIV-positive patients in regions in which tuberculosis is endemic
	Isoniazid at a dose of 900 mg plus rifapentine at a dose of 900 mg weekly for 3 mo (directly observed therapy)	Studied with directly observed therapy in predominantly HIV-uninfected persons; higher completion rates and equal efficacy, as compared with isoniazid for 9 mo
	Rifampin at a dose of 600 mg daily for 4 mo	Shown to be effective in persons with silicosis
	Isoniazid at a dose of 300 mg plus rifampin at a dose of 600 mg daily for 3 mo	Effective alternative for HIV-infected persons
	Isoniazid at a dose of 900 mg plus rifampin at a dose of 600 mg twice weekly for 3 mo	Another effective alternative for HIV-infected persons

**N Engl J Med 2013;368:745-55.**

# TB Prophylaxis:

## Mass INH Preventive Therapy



*The* NEW ENGLAND  
JOURNAL *of* MEDICINE

ESTABLISHED IN 1812

JANUARY 23, 2014

VOL. 370 NO. 4

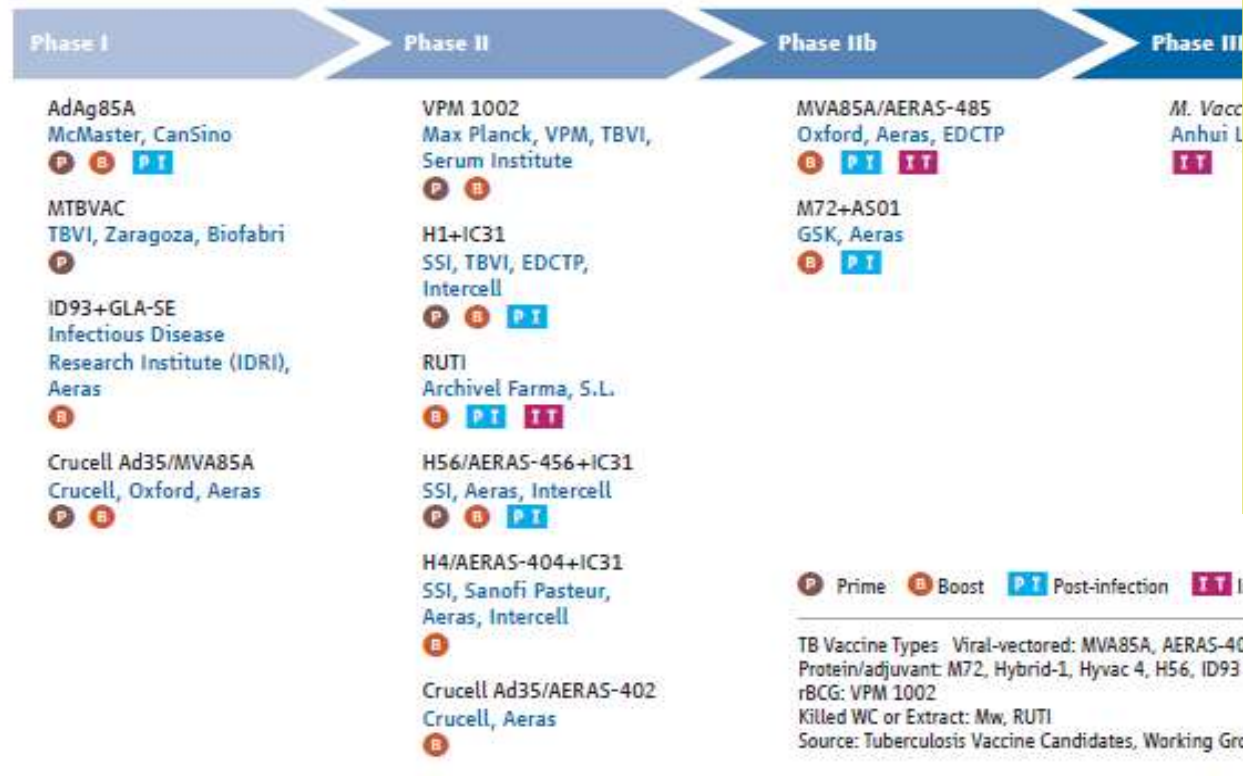
### A Trial of Mass Isoniazid Preventive Therapy for Tuberculosis Control

Gavin J. Churchyard, M.B., B.Ch., Ph.D., Katherine L. Fielding, Ph.D., James J. Lewis, Ph.D., Leonie Coetzee, D.Soc.Sc., Elizabeth L. Corbett, M.B., B.Chir., Ph.D., Peter Godfrey-Faussett, F.R.C.P., Richard J. Hayes, D.Sc., Richard E. Chaisson, M.D., and Alison D. Grant, M.B., B.S., Ph.D., for the Thibela TB Study Team

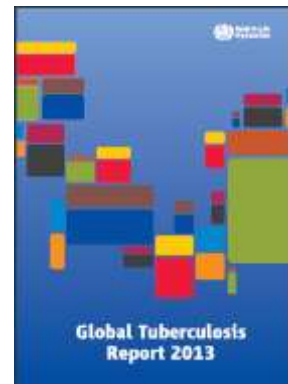
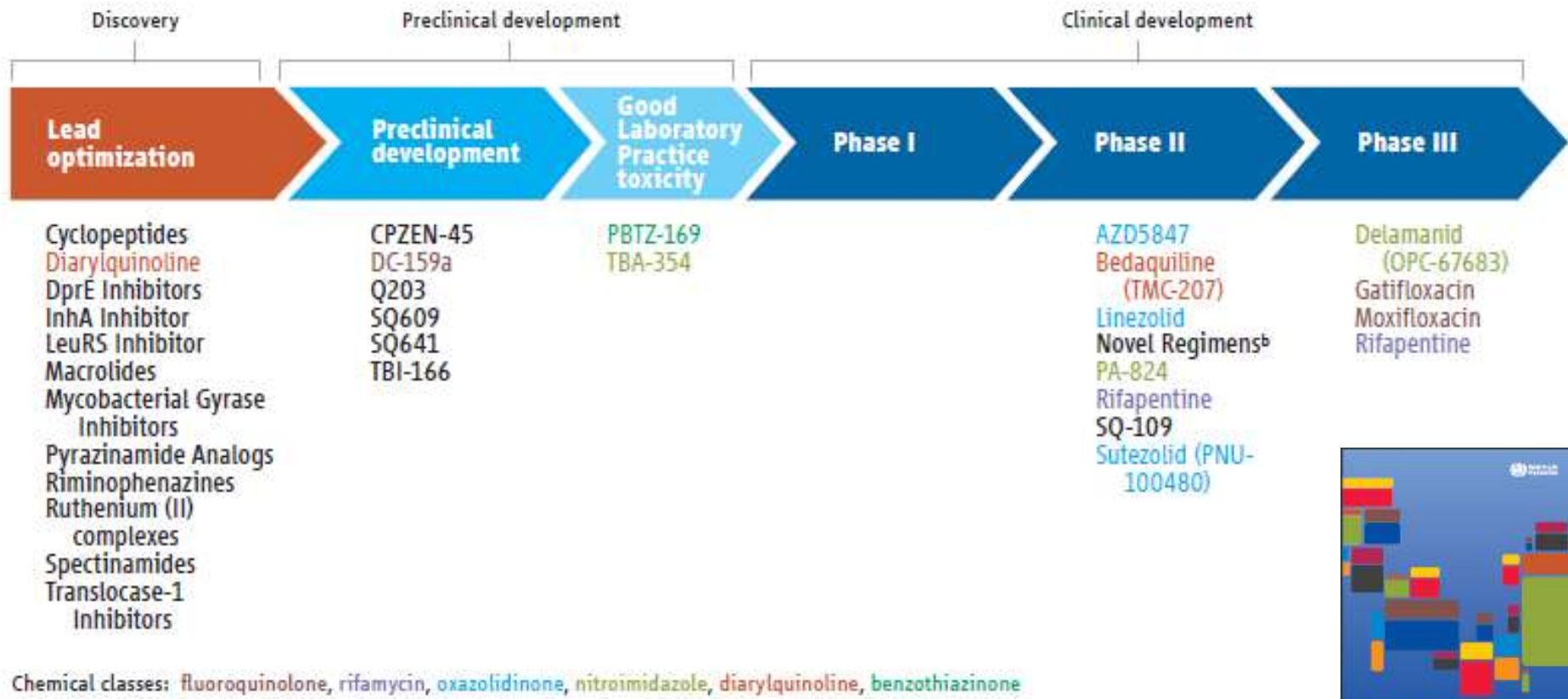
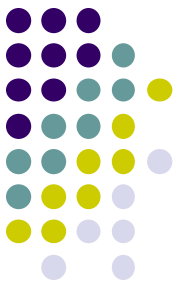
# Vaccines



The development pipeline for new TB vaccines, July 2013



# Therapeutics

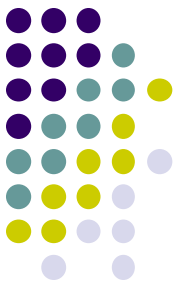




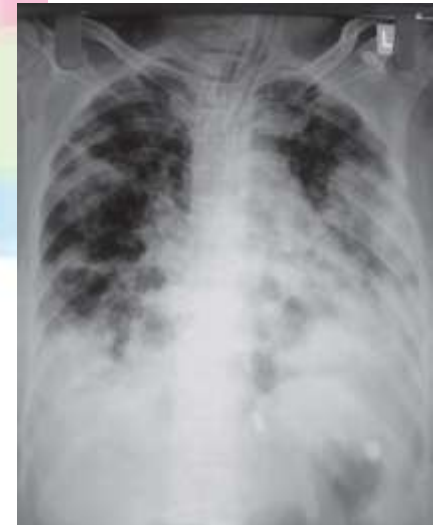


# Electrolytes and Acid Base Disturbance

# TB and Electrolytes: Impact of Aminoglycosides



Parameters	Case 1	Case 2
Urea mg/dl	32	14
Creatinine mg/dl	1.1	0.9
Sodium meq/L	129	132
Potassium meq/L	2.1	2.8
Magnesium mg/dl	0.8	1.1
Calcium mg/dl	5.6	6.2
Phosphorus mg/dl	3.6	2.8
24 hr urine calcium (Normal upto 300 mg/24 hr)	84	112
24 hr urine phosphorus (normal upto 0.6-1.2 gm/24 hr)	224	320
24 hr urine magnesium (normal<150 mg/24 hr)	1.2 gm/24 hr	0.92 gm/24 hr



Indian Journal of Endocrinology and Metabolism / 2013 / Vol 17 / Supplement 1

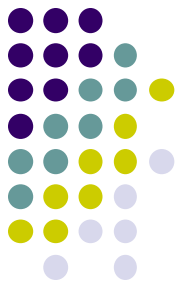
# TB and Electrolytes: Hypercalcemia



Hindawi Publishing Corporation  
Clinical and Developmental Immunology  
Volume 2013, Article ID 928138, 5 pages  
<http://dx.doi.org/10.1155/2013/928138>

*Research Article*

**Elevated 1- $\alpha$  Hydroxylase Activity in Monocytes from  
Patients with Active Tuberculosis**



# INH and Acid Base Disturbance

PLASMA (mEq/L)	P <sub>Na</sub>	P <sub>Cl</sub>	P <sub>HCO<sub>3</sub></sub>
Normal	140	103	25
L-Lactic acid (10 mmol/L)	140	103	15 = 25 - 10



*Causes of elevated anion gap metabolic acidosis:*

## **MUDPILES**

**M**ethanol, metabolism  
(inborn errors)

**U**remia

**D**iabetic ketoacidosis

**P**araldehyde

**I**ron isoniazid

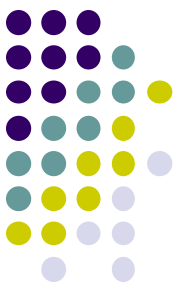
**L**actic acidosis

**E**thylene glycol

**S**alicylates, strychnine

Na <sup>+</sup> (140)	AG (12)	Albumin	
	+ 10	Lactate <sup>-</sup>	(10)
		HCO <sub>3</sub> <sup>-</sup>	(15)
		Cl <sup>-</sup> (103)	
Na <sup>+</sup> (140)	AG (12)	Albumin	
		HCO <sub>3</sub> <sup>-</sup>	(15)
		Cl <sup>-</sup> (113)	





Journal List > Indian J Nephrol > v.22(5); Sep-Oct 2012 > PMC3544064

	Official publication of the Indian Society of Nephrology		Home
	Indian Journal of Nephrology		Current issue
			Instructions
			Submit article

Indian J Nephrol. 2012 Sep-Oct; 22(5): 385–387.

PMCID: PMC3544064

doi: [10.4103/0971-4065.103930](https://doi.org/10.4103/0971-4065.103930)

## Fatal poisoning by isoniazid and rifampicin

[A. Sridhar](#), [Y. Sandeep](#), [C. Krishnakishore](#), [P. Sriramnaveen](#), [Y. Manjusha](#), and [V. Sivakumar](#)

[Chest](#). 1971 Mar;59(3):245-8.

**Isoniazid toxicity: reports of lactic acidosis and keratitis.**

[Neff TA](#).



# TB and AKI

# TB Treatment: Acute Kidney Injury



Chang et al. *BMC Infectious Diseases* 2014, **14**:23  
<http://www.biomedcentral.com/1471-2334/14/23>



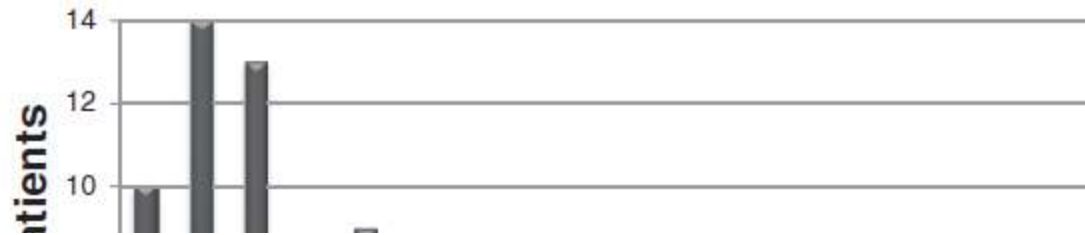
**RESEARCH ARTICLE**

**Open Access**

## Acute kidney injury due to anti-tuberculosis drugs: a five-year experience in an aging population

Chia-Hao Chang<sup>1</sup>, Yen-Fu Chen<sup>2</sup>, Vin-Cent Wu<sup>3</sup>, Chin-Chung Shu<sup>4</sup>, Chih-Hsin Lee<sup>5</sup>, Jann-Yuan Wang<sup>3\*</sup>, Li-Na Lee<sup>6</sup> and Chong-Jen Yu<sup>3</sup>

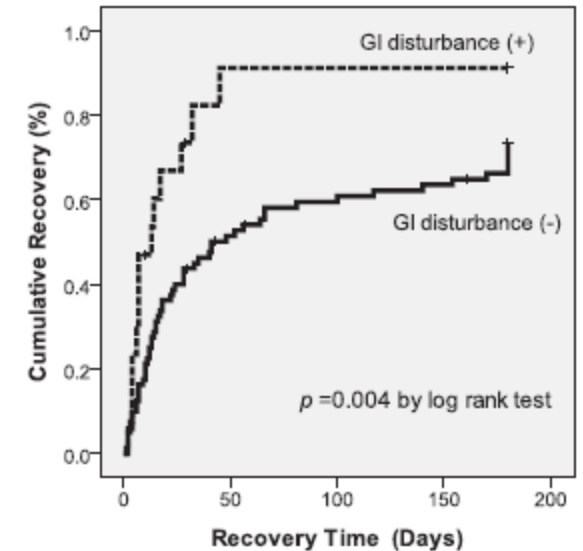
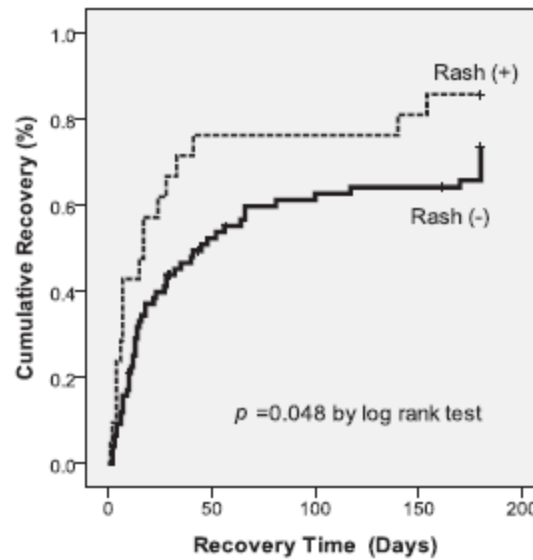
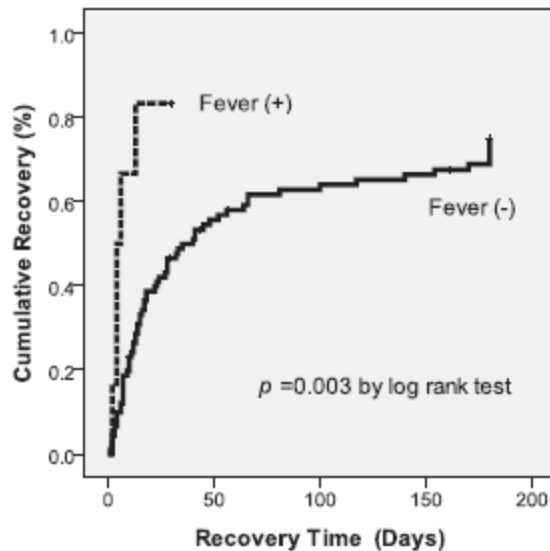
# TB Treatment: Acute Kidney Injury



(A)

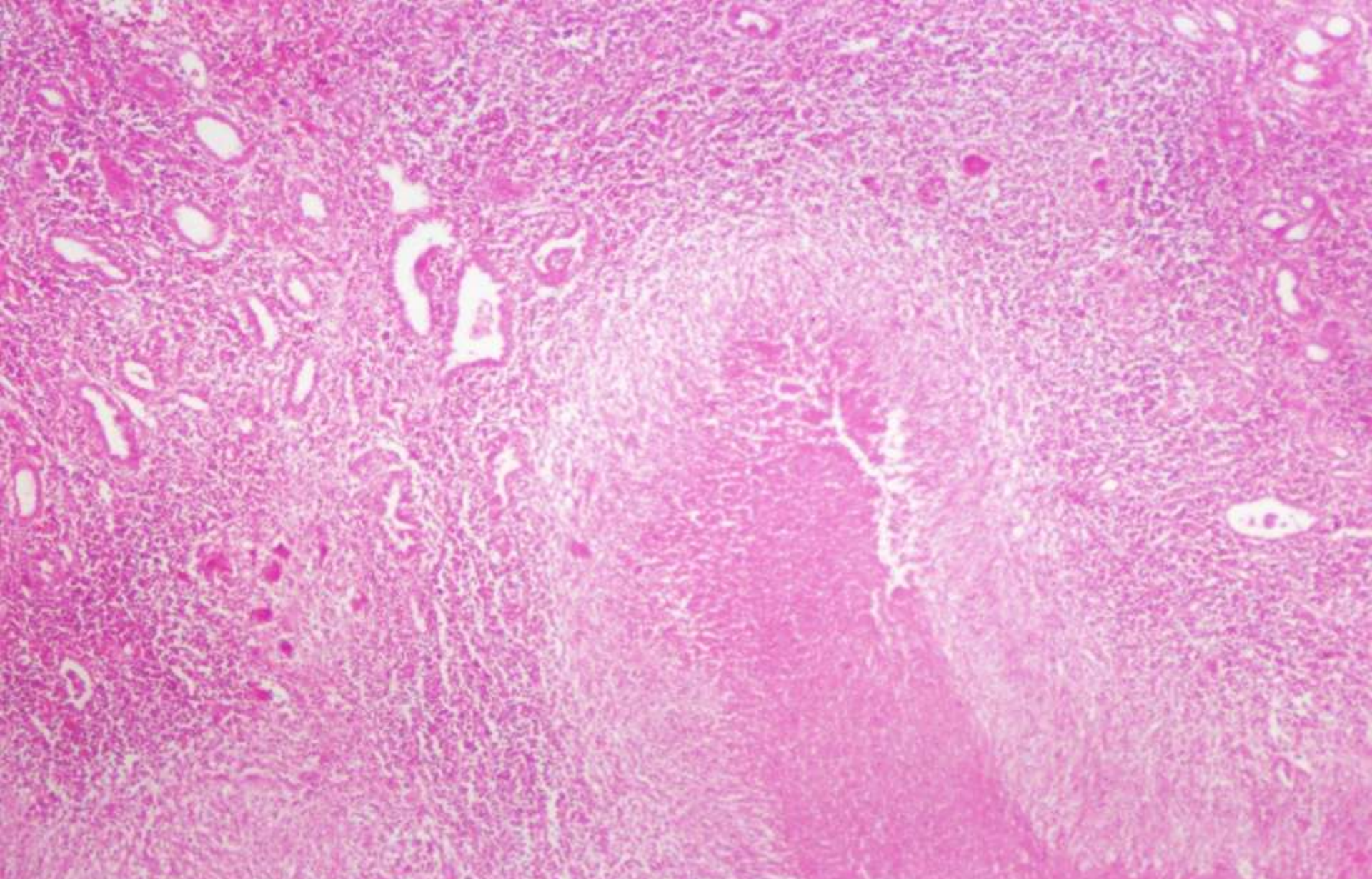
(B)

(C)



BMC Infectious Diseases 2014, 14:23

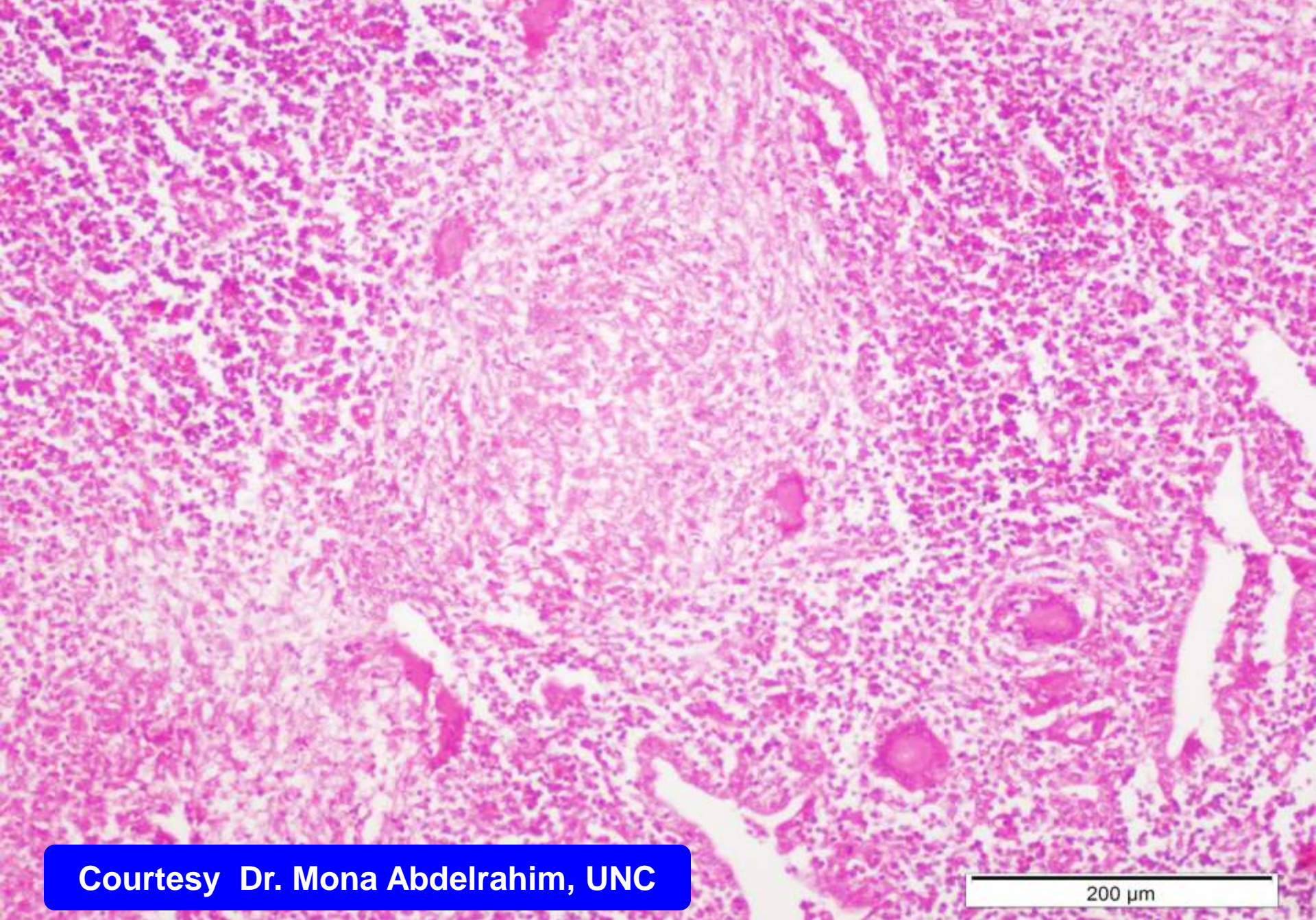




**Courtesy Dr. Mona Abdelrahim, UNC**

200  $\mu$ m





**Courtesy Dr. Mona Abdelrahim, UNC**

200 μm



# A 30-y-old Woman Presented With Fatigue and Elevated Creatinine



Hindawi Publishing Corporation  
Case Reports in Nephrology  
Volume 2013, Article ID 724693, 3 pages  
<http://dx.doi.org/10.1155/2013/724693>

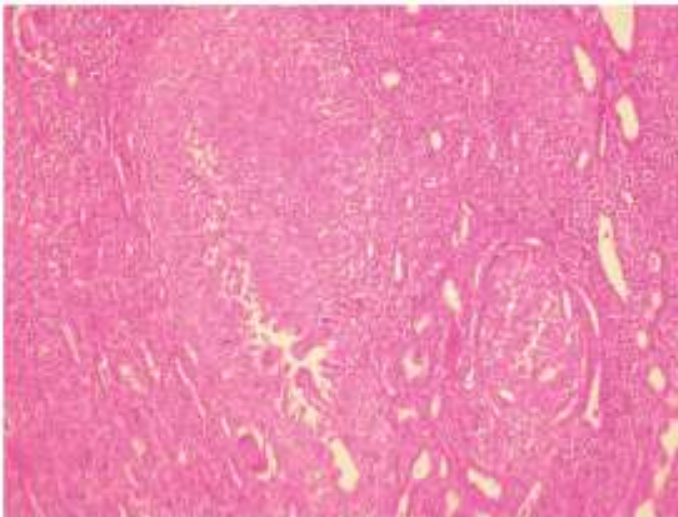
## Case Report

### Bilateral Renal Mass-Renal Disorder: Tuberculosis

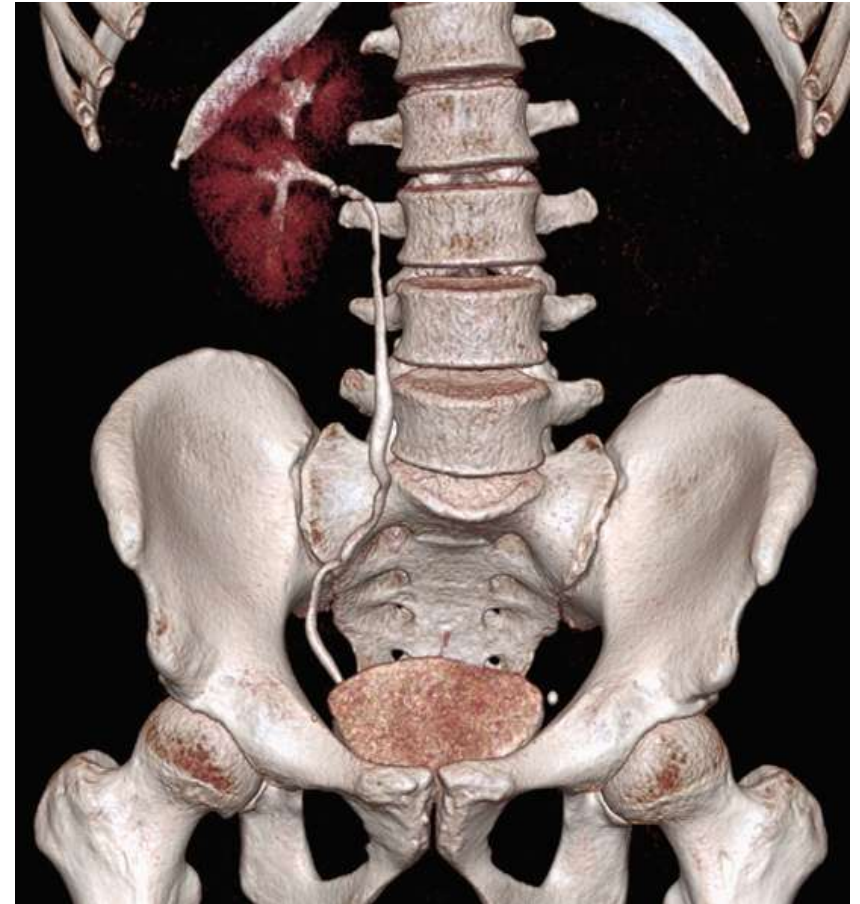
Ozlem Tiryaki,<sup>1</sup> Celalettin Usalan,<sup>1</sup> and Samet Alkan<sup>2</sup>

<sup>1</sup> Department of Nephrology, Gaziantep University School of Medicine, Gaziantep, Turkey

<sup>2</sup> Department of Internal Medicine, Gaziantep University School of Medicine, Gaziantep, Turkey

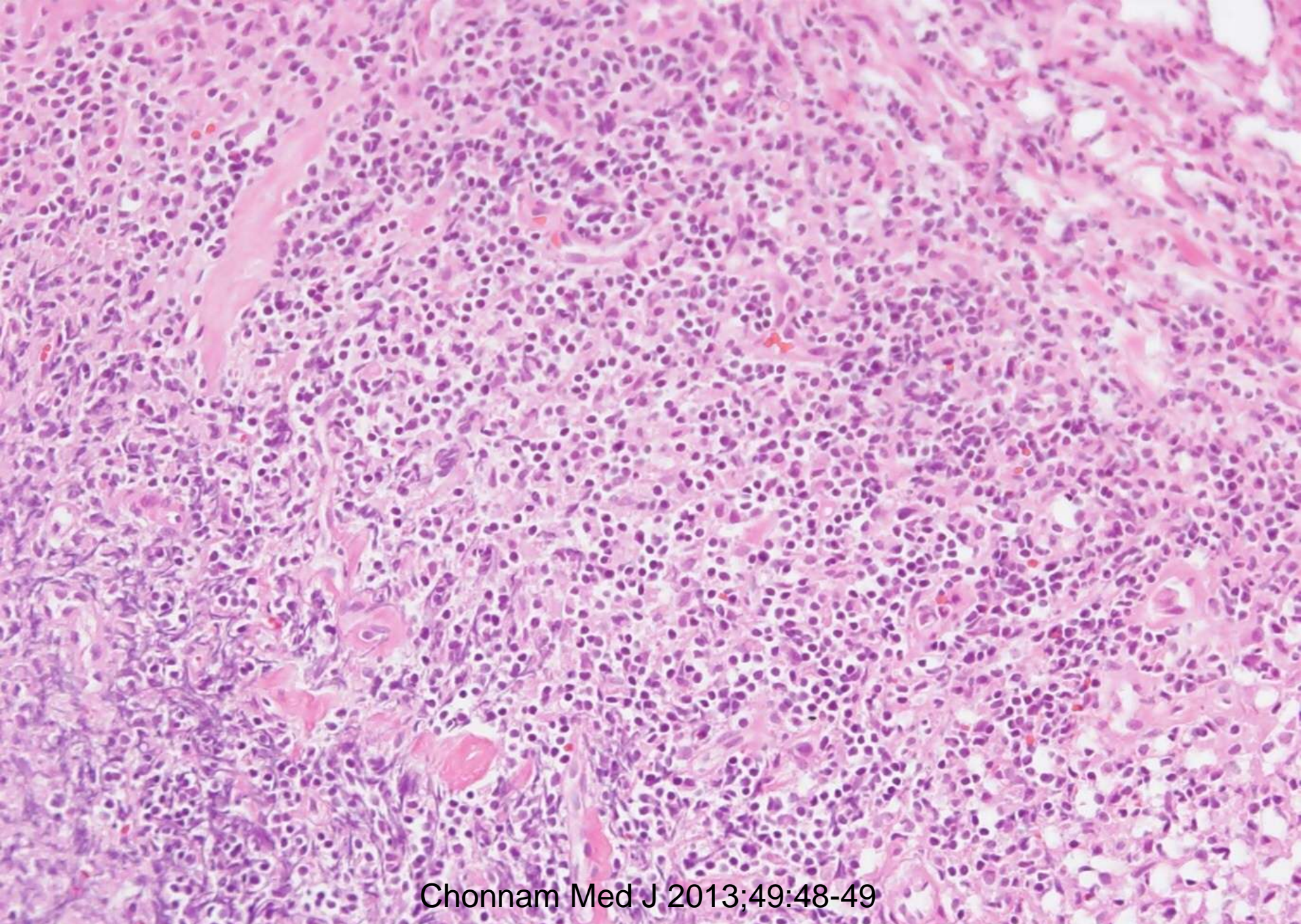


# Gross Hematuria and AKI



Chonnam Med J 2013;49:48-49C

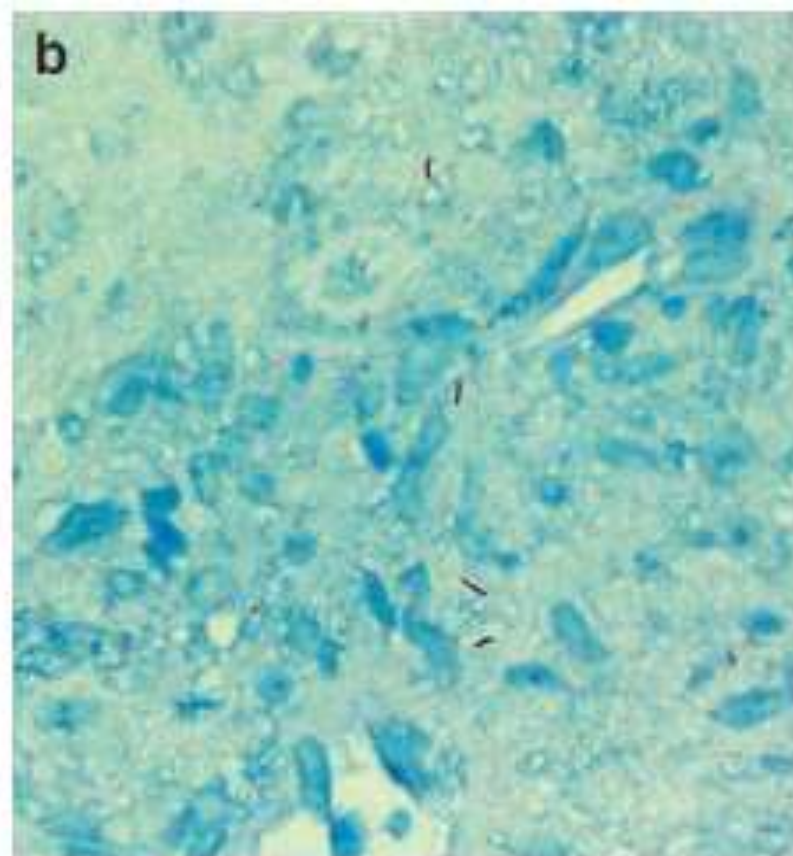
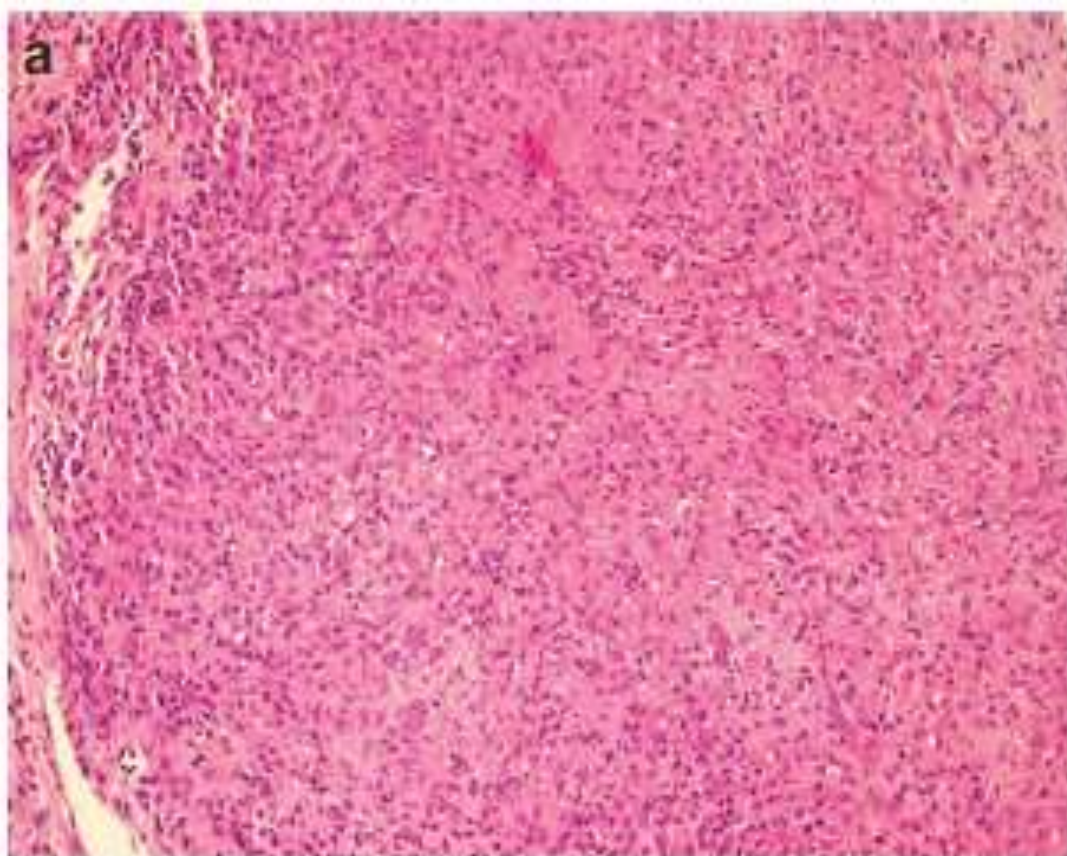




Chonnam Med J 2013;49:48-49



## The Case | Reversible rapidly progressive renal failure with loss of vision



Clin Kidney J (2012) 5: 364–365  
doi: 10.1093/ckj/sfs084

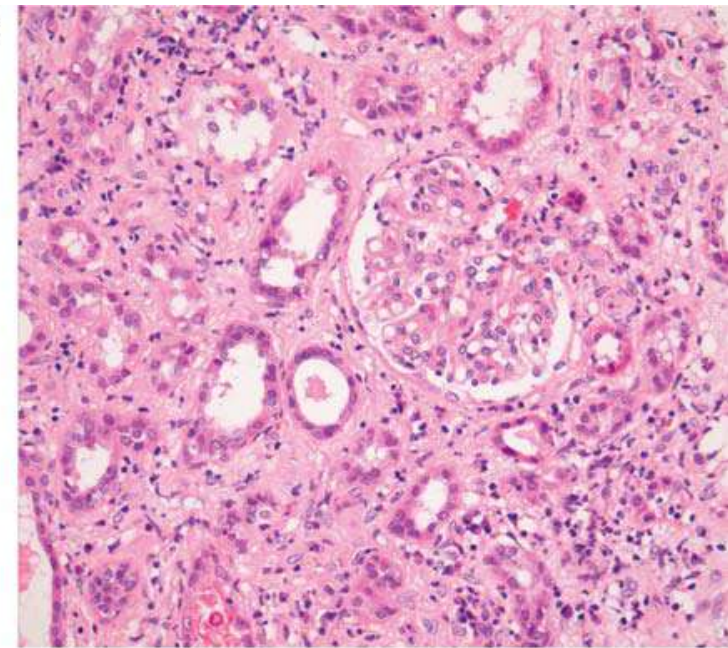
*Nephroquiz*  
(Section Editor: M. G. Zeier)

## Tuberculosis, acute kidney injury and pancreatitis—what is the underlying cause?

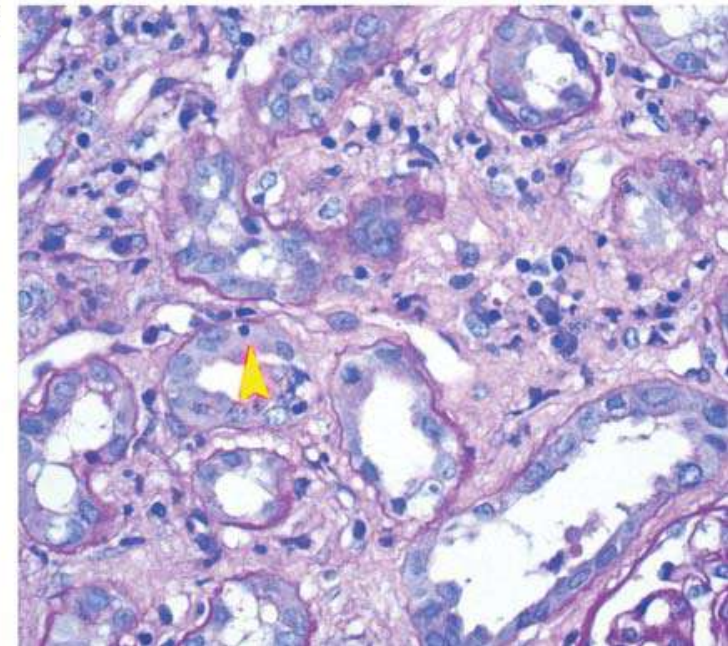
Kate Topping<sup>1</sup>, Beena Nair<sup>1</sup>, Aimun Ahmed<sup>2</sup> and Alexander Woywodt<sup>2</sup>

<sup>1</sup>Departments of Nephrology and Pathology, Preston, Lancashire, UK and <sup>2</sup>Lancashire Teaching Hospitals NHS Found. Preston, Lancashire, UK

A



B





# TB and Electrolytes:

## Hypokalemic paralysis and AKI



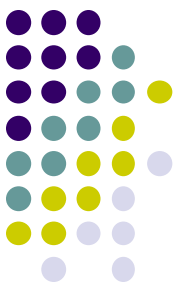
Biochemical Data on Admission and after Rifampin Withdrawal

	Admission	2 weeks	3 months	6 months	8 months
<b>Serum</b>					
Urea nitrogen (mg/dL)	13.9	-	18.5	15.9	15.9
Creatinine (mg/dL)	1.4	-	1.12	1.18	1.09
Potassium (mmol/L)	2.0	3.8	3.8	3.7	4.3
pH	7.289	7.260	7.387	7.381	7.367
Bicarbonate (mmol/L)	12.4	14.5	22.8	23.3	24.4
Phosphate (mg/dL)	1.2	2.7	5.2	4.4	4.6
Uric acid (mg/dL)	1.2	1.3	3.9	4.5	4.2
Sodium (mmol/L)	141	140	140	140	142
Chloride (mmol/L)	114	112	103	103	106
Magnesium (mg/dL)	2.1	2.3	2.5	2.3	2.3
Albumin (g/dL)	4.7	-	-	4.3	4.3

BMC Nephrology 2013, 14:13







Nephron. 2002 Jan;90(1):116-8.

**Rapidly progressive glomerulonephritis due to rifampicin therapy.**

Yoshioka K<sup>1</sup>, Satake N, Kasamatsu Y, Nakamura Y, Shikata N.



# TB and Kidney Transplantation

# TB Transmission: Transmitted From A Donor

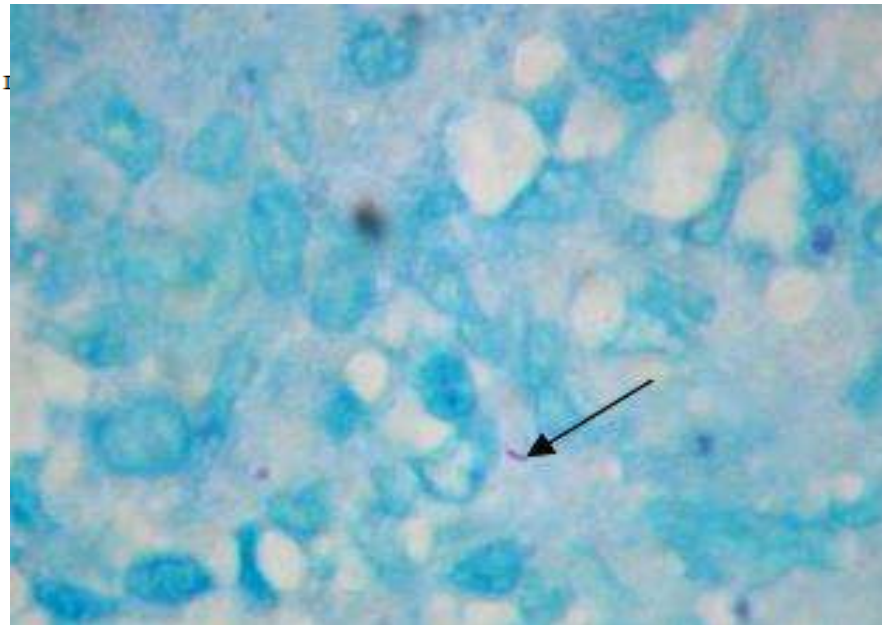


Saudi J Kidney Dis Transpl 2014;25(2):370-375  
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**Saudi Journal  
of Kidney Diseases  
and Transplantation**

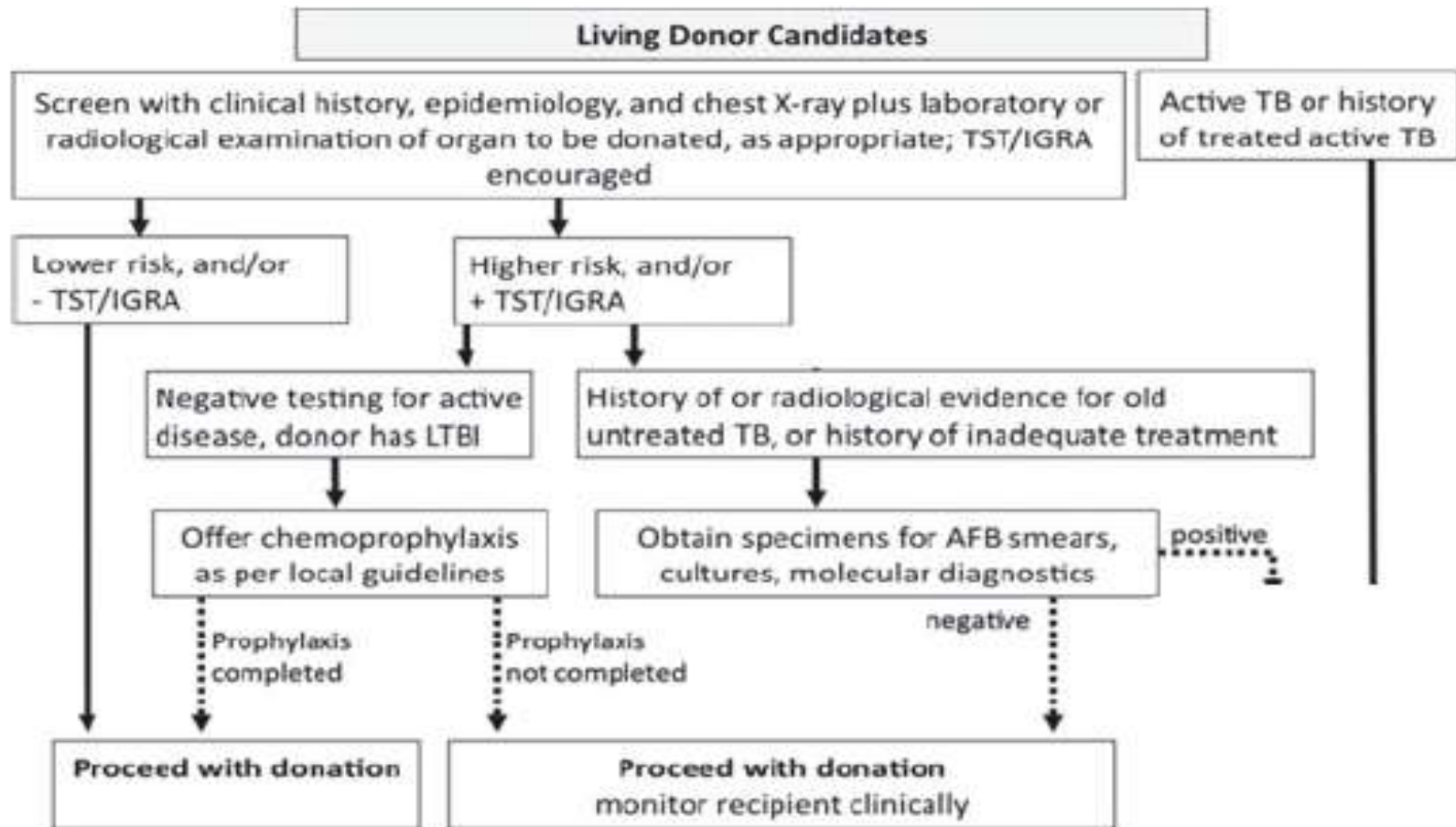
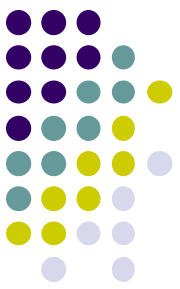
## Case Report

**Renal Allograft Tuberculosis with Infected Lymphocele Transmitted  
from the Donor**



# TB Transmission:

## Transmitted From A Donor



*American Journal of Transplantation 2012; 12: 2288–2300*

# TB after Transplantation



*American Journal of Transplantation 2011; xx: 1–2  
Wiley Periodicals Inc.*

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Transplantation and the American Society of Transplant Surgeons

Editorial

doi: 10.1111/j.1600-6143.2011.03626.x

## **The Current State of Tuberculosis in Solid Organ Transplantation: Three Principles for Optimal Management**



# TB after Transplantation



Hindawi Publishing Corporation  
BioMed Research International  
Volume 2013, Article ID 347103, 9 pages  
<http://dx.doi.org/10.1155/2013/347103>

**16/491(3.2%)**

*Research Article*

***Mycobacterium tuberculosis* Infection following  
Kidney Transplantation**

Karima Boubaker,<sup>1</sup> Tahar Gargah,<sup>2</sup> Ezzedine Abderrahim,<sup>1</sup>  
Taieb Ben Abdallah,<sup>3</sup> and Adel Kheder<sup>1</sup>

# TB after Transplantation

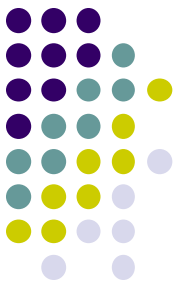


**74/16146 (0.45%)**

Nephrol Dial Transplant (2011) 26: 3773–3778  
doi: 10.1093/ndt/gfr156  
Advance Access publication 5 April 2011

**Tuberculosis following kidney transplantation: clinical features and outcome. A French multicentre experience in the last 20 years**

# TB after Transplantation



45/1200 (3.8%)

Tuberculosis in Egyptian kidney transplant recipients: Study of clinical course and outcome

J Nephrol 2003; 16(3): 404 - 411

Article Type: ORIGINAL ARTICLE

Authors

A.E. El-Agroudy, A.F. Refaie, O.M. Moussa, M.A. Ghoneim



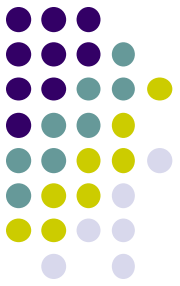
# TB after Transplantation



■ ORIGINAL ARTICLE

**Tuberculosis prevalence in renal transplant recipients: systematic review and meta-analysis**

*J Bras Nefrol 2013;35(3):206-213*



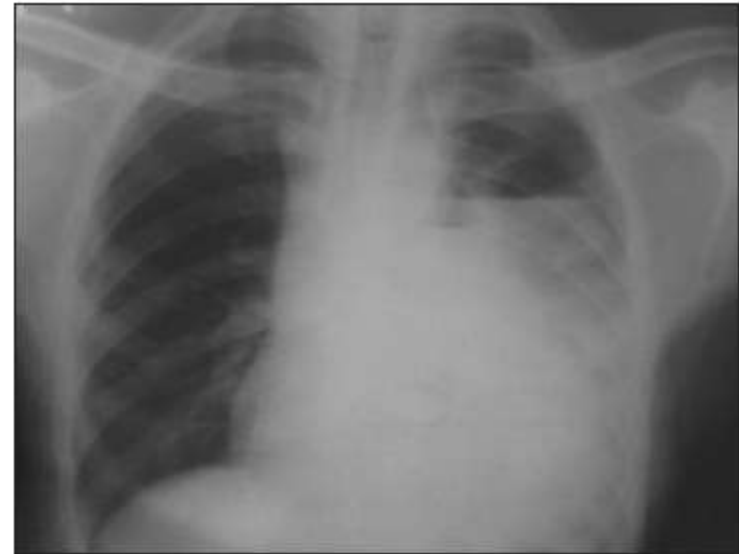
# Miscellaneous



# TB and Diabetes

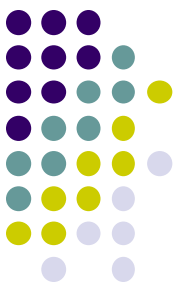


**Unusual presentation of renal tuberculosis in type 2 diabetes**



Nigerian Journal of Clinical Practice • Oct-Dec 2012 • Vol 15 • Issue 4

# Urinary TB and Urothelial Carcinoma



FULL PAPER

**BJC**

British Journal of Cancer (2013) 109, 2933–2940 | doi: 10.1038/bjc.2013.538

Keywords: cohort study; obstructive uropathy; Taiwan; tuberculosis; urinary tract cancer; National Health Insurance Research Database

**Urinary tuberculosis is associated with the development of urothelial carcinoma but not renal cell carcinoma: a nationwide cohort study in Taiwan**

# INH Toxicity in ESRD



Indian J Nephrol. 2013 Jan-Feb; 23(1): 54–56.

PMCID: PMC3621241

doi: [10.4103/0971-4065.107206](https://doi.org/10.4103/0971-4065.107206)

## Encephalopathy secondary to isoniazid in patients on hemodialysis



### Cause

#### *Drug*

BCG, intravesical

Antibiotics (ampicillin, vancomycin, cefuroxime, clarithromycin, fluoroquinolone, rifampin, etc.)

NSAIDs

Diuretics (thiazide)

Allopurinol

Anticonvulsant (lamotrigine)

Omeprazole

Bisphosphonate

All-*trans* retinoic acid

Heroin abuse

#### *Infection*

Bacteria (*E. coli*, rhodococcus, etc.)

*Mycobacterium tuberculosis*

Virus (adenovirus, HIV, etc.)

Fungus (histoplasma, candida, cryptococcus, etc.)

#### *Inflammatory or systemic condition*

Sarcoidosis

Wegener's granulomatosis

Tubulointerstitial nephritis and uveitis syndrome

Crohn's disease

Hematologic malignancy (leukemia, multiple myeloma)

#### Idiopathic

200  $\mu$ m

# Is It True or False?



1. Latent TB affects one 1/3 of whole world
2. Quantiferon test measures the number of active Tcells.
3. Genitourinary TB (GUTB) is the most common extrapulmonary TB.
4. GUTB affects male aged less than 20 years.
5. Kidney is the most common site of GUTB.



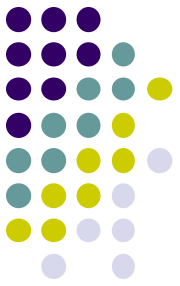
# Is It True or False?



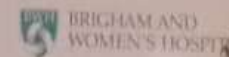
1. Renal medulla is the most common site of involvement of clinical renal TB.
2. CT or MR images are definitive in diagnosing urinary TB
3. Xpert MTB/RIF is a new culture takes 42 days.
4. INH may cause normal anion gap acidosis.
5. Rifampicin is a common culprit causing TIN.
6. Ethambutol is the most potent enzyme inducer among anti-TB drugs.

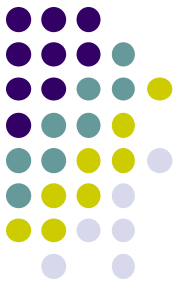
Now this is not the end. It is not even the beginning of the end. But it is, perhaps, the end of the beginning.

Winston Churchill



Now, this is not the end.  
It is not even the beginning of the end.  
But it is, perhaps, the end  
of the beginning.





- على المرء أن يسعى ويبذل جهده وليس عليه أن يساعده الدهر
- فإن نال بالسعي المنى تم أمر وإن غلب المقدور كان له عذر

